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FISH PLANTING IN PUBLIC WATERS

By TARLETON H. BEAN, M.S., M.D.
State Fish Culturist

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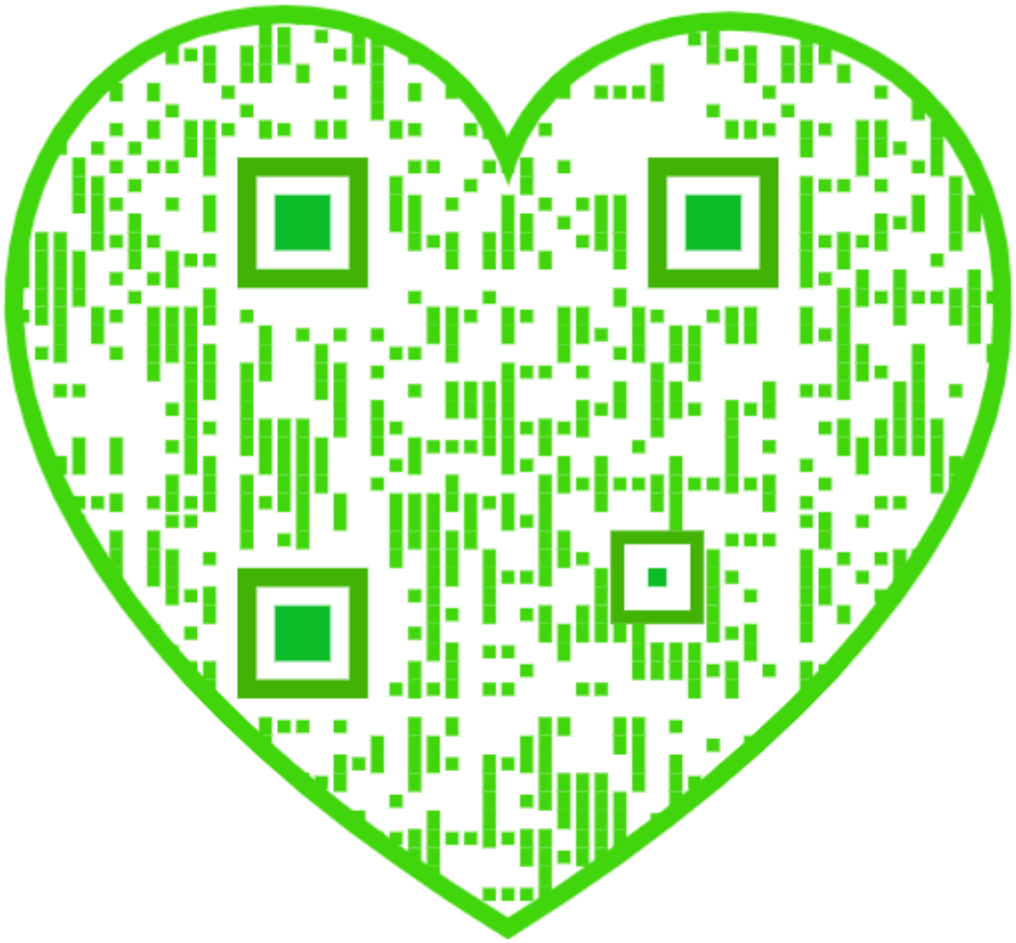
STATE OF NEW YORK
CONSERVATION COMMISSION
ALBANY



New York (State) Conservation Commission. Division of fish and game

FISH PLANTING IN PUBLIC WATERS

A Guide for Stocking the Inland Waters of New York State with Food and Game Fish

By

TARLETON H. BEAN, M. S., M. D.

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STATE OF NEW YORK

CONSERVATION COMMISSION

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The Value of Fish and Fishing

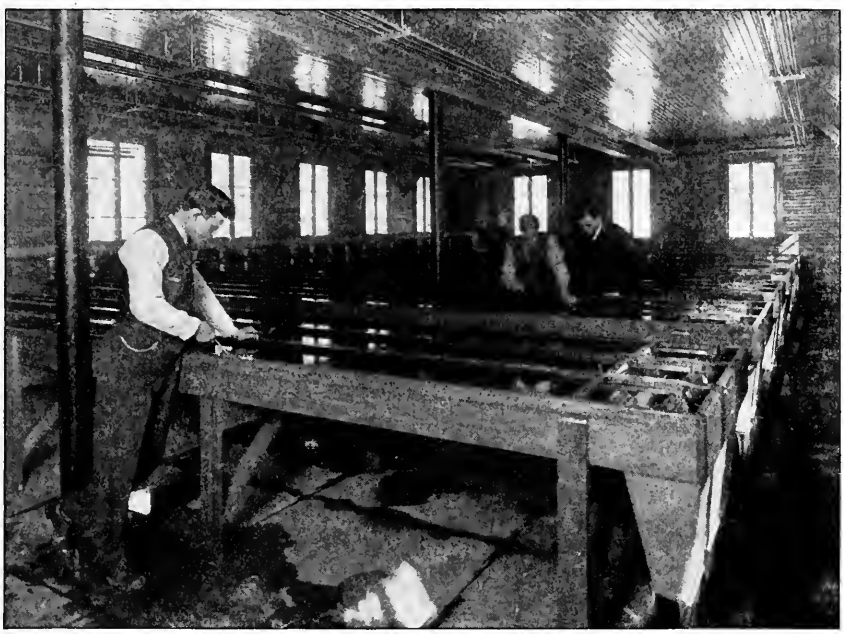
While no figures are available on which to base an estimate of the value of both food and game fish annually taken from the waters of New York State, there is ample justification for believing that this would run into millions of dollars. The returns from licensed net fishermen alone show that in 1915 5,886,031 pounds of fish of all kinds were taken by them from the waters of the State, outside of the marine district, the estimated value of which was $296,362.91. There are still other advantages of good fishing that are too tremendous to be calculated in dollars and cents. Untold thousands of people are attracted each year to vacation resorts on the lakes and streams of the State, largely by reason of the fishing afforded there; and the amount of health and pleasure that they derive from angling pursuits is infinitely more important than the mere market value of the fish that they catch. If it were not, however, for extensive artificial propagation and the stocking of inland waters with the hatchery products, the natural supply of the State's best fish would long since have been brought to the point of exhaustion, and the State would have been deprived of one of its most important natural resources.

Fish Propagation and Distribution in New York

State fish culture in New York is carried on under the direction of the Conservation Commission. Eleven hatcheries are maintained, located at Bath, Bemus Point, Cold Spring Harbor, Constantia, Linlithgo, Margaretville, Mumford, Ogdensburg, Old Forge, Upper Saranac and Warrensburg. In 1915 there were distributed from them 845,756,551 fry and fingerlings, representing about thirty species. The annual value of the hatchery output, computed at the prevailing market rates is upwards of $200,000. Nevertheless the annual cost of maintaining the hatcheries is only about $75,000. Thus a large financial saving is effected by the State operating its own hatcheries.

The Commission supplies fish only for public waters, and not for private preserves or other posted property. Persons who desire to stock streams or lakes may obtain from the Commission blank forms containing questions which, when properly answered, furnish a means of determining the

The Warrensburg Hatchery, built in 1915.

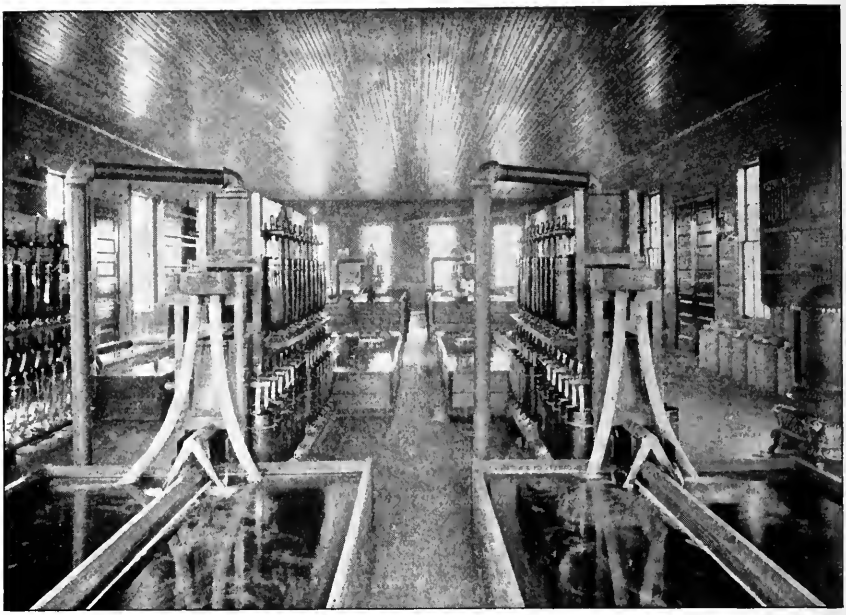


Hatching and rearing tanks for brook trout in the Warrensburg Hatchery.

kind and number of fish required for the waters. Applications for trout must be sent in before February 1, and those for all other species before April 1. Only one application will be granted for a single stream or lake, except in the care of large waters, and then only for planting at different points. Over 6000 applications were received and granted in 1915, about 70 fish and game associations being numbered among the applicants.

Artificial Hatching More Efficient than Natural Propagation

Under natural spawning conditions, eggs and young fish are exposed to multitudes of enemies. Freshets bring down sediment that covers up and smothers eggs resting upon the stream bottoms. Certain fish, including minnows, suckers, and sculpins, devour great quantities of eggs of other and more valuable species. The larger predaceous fish prey upon the young of practically all species. Diseases may attack fish at any stage of their existence, especially in polluted waters. Consequently it is quite safe to say that a mere fraction of one per cent of all the eggs naturally deposited ever become mature fish. In artificial propagation, on the other hand, the percentage of loss in hatching has been reduced to trifling proportions. The very high state of efficiency attained in the hatcheries makes this phase of fish culture profitable.



Jars for hatching pike perch in the Oneida Hatchery.

Necessity of Efficiency in Planting

It is in the highest degree desirable that this same efficiency should be extended to the planting methods. The Commission itself plants practically all of its food fish, but at present direct supervision over the game fish practically ceases when the cans of fry or fingerlings are delivered on the platforms of the railway stations. In many cases the lack of special knowledge and experience on the part of those who transport the cans to the streams and do the actual planting results in great loss. Thus certain waters that have been stocked with thousands upon thousands of fry and fingerlings during a long period of years still produce, for one reason or another, very indifferent, if any, fishing. The planting of food fish by the Commission, however, is uniformly successful, indicating that proper attention to details will bring results.

In order, therefore, to devise more intelligent and effective methods of stocking and protection, based upon thorough knowledge of the actual conditions obtaining in the streams and lakes, the Commission has undertaken an intensive investigation of the waters of the State. Some of the principal subjects for investigation are the following: the distribution and habitats of the fish found at present in these waters; their food habits, as determined by analysis of their stomach contents; the supply of natural food available, such as insects, mollusks, crustaceans, worms, and aquatic vegetation; the spawning seasons of the various fish; their natural enemies;

Greenback herring for spawn are caught in pound nets at Sodus Bay on Lake Ontario.

stream pollution and methods of controlling it; proper open and closed seasons; methods of cooperation between the Commission and associations and individuals interested in propagating or protecting fish. It is confidently believed that this investigation will lay the foundation for a marked increase in the quantity, as well as for improvement in the quality, of the fishing in New York State.

Pending the completion of the first season's study, and the publication of the detailed results and working plans, the Commission has issued the present bulletin, which furnishes concise information and general directions for planting the various species of fish distributed from the State hatcheries.

GENERAL PRINCIPLES OF STOCKING

Stream Study and Plans Essential Preliminaries

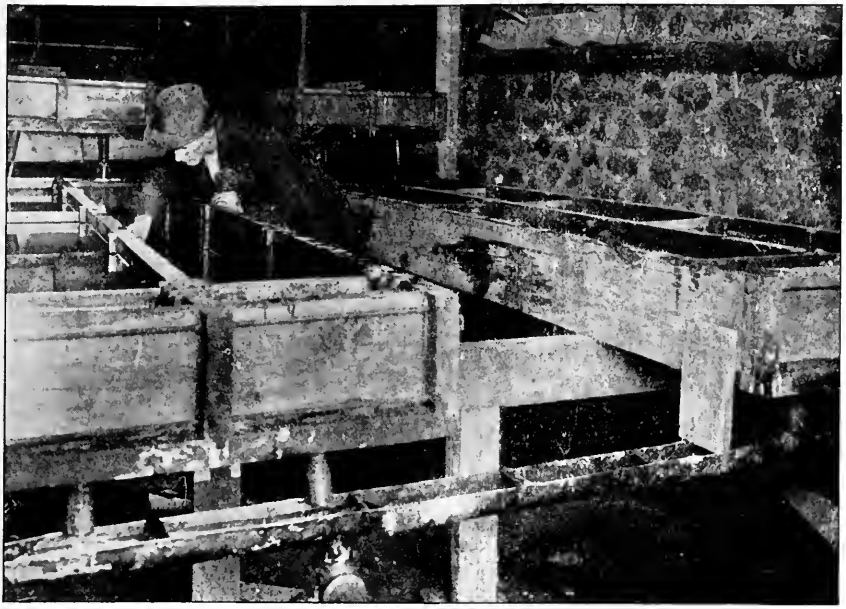
Plans for stocking should be made during the driest part of the preceding season. Only the streams or parts of streams that have not then dried up or become stagnant should be considered in the plans for future planting. Every detail regarding the adaptability of the stream or lake for the fish that it is desired to plant should be carefully considered. Foresight in this direction will save many fish that would otherwise be lost.

Collecting spawn from greenback herring.

Planting Points and Food Supply

The two chief requirements of young fish are protection and food. They need protection from predaceous enemies, freshets, drought and disease. In general, for stream-inhabiting species, the headwaters furnish the most suitable planting points. Here the larger fish are not apt to be present to prey upon the fry. Freshets are not so strongly felt there, and are less likely to wash the small fish downstream. Moreover the chances of pollution are much less. Care must be taken, on the other hand, not to plant the fish in streams or headwaters which may dry up in time of drought. For the young of lake fish the most favorable situations are generally the shallow waters near shore, or on shoals or reefs. In either case, whether dealing with brook fish or lake fish, it is well to discover, if possible, the natural spawning beds, and to plant the young in or close to such places; for it is reasonable to suppose that each species has come to choose for its spawning grounds the places that are most suitable for its young to hatch and live in. These situations are likely to be supplied with the natural food that the young require. As the fish grow they will gradually work their way into the deeper and wider waters inhabited by the adults.

While we have only a meagre knowledge of the food of fish at the earliest period of their lives, we know in a very general way what the adults of the



This receiving station for the temporary care of trout fry has a capacity of 120,000.

commoner species feed upon. It is of particular importance, therefore, when introducing any species into waters where it has not occurred previously, to ascertain whether a suitable supply of its natural food is available. The food requirements of various species are stated in the pages that follow.

Fry Versus Fingerlings

Opinions differ as to the superiority of fry or fingerlings* for stocking purposes. The expense of rearing fish to fingerling size, and of transporting them at that age, is very considerable. In many hatcheries space is not available for keeping fingerlings, and it is therefore necessary to distribute a large proportion of the annual product before the fish have advanced beyond the fry stage. A very much greater number of fry than of fingerlings can be supplied for a given stream. Furthermore, the important instinct of self-preservation is undoubtedly developed better and sooner in fish that are planted at the earlier age. For these reasons many persons consider that the advantages of fry planting outweigh its disadvantages. They believe that more fish will grow to maturity from several

*When a fish hatches from the egg, it has a small yolk sac which is filled with nutriment and is gradually absorbed. While the sac is still carried, and for a short time thereafter, the young fish are called *fry*. After they reach a length of one and a half or two inches, and until they become a year old, they are known as *fingerlings*.

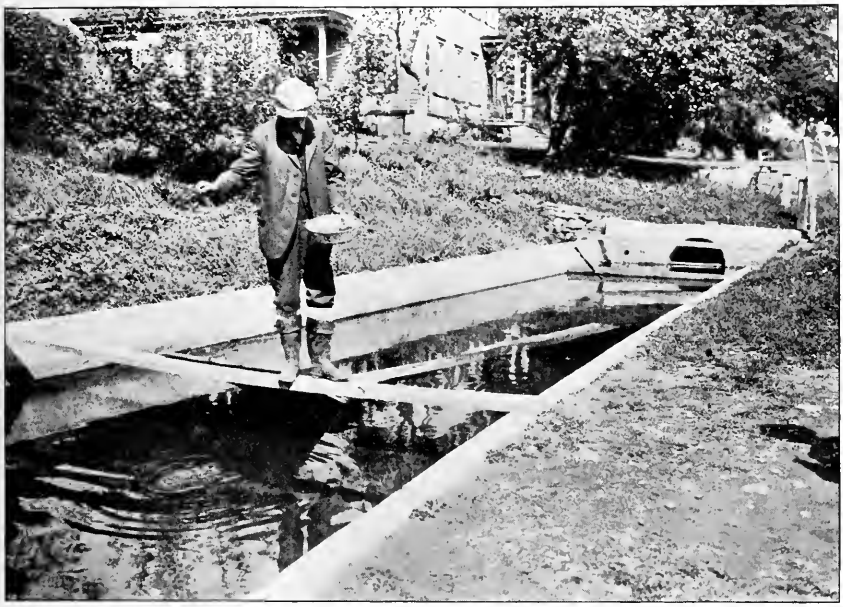
Stream pools on small feeder brooks cost nothing to build and maintain.

thousand fry than from a few hundred fingerlings. The hatcheries of all of the different states and the United States distribute fry, and their experience has demonstrated beyond question that fry planting can be made very effective. The prejudice against fry planting can usually be traced to improper planting methods, or to unsuitable streams. It should not be forgotton that nature herself plants fry exclusively.

Care During Transportation

The fry and fingerlings of most species are distributed in spring and early summer. The cans containing these young fish are accompanied from the hatcheries by a messenger, who cares for them during the railway journey. The water in the cans must be kept constantly aerated, so that the fish will not suffocate from lack of oxygen. Unless special apparatus is provided, this is done by hand, water being dipped up from the top of the can and allowed to fall back from a height. Such attention is required at least every half hour. The water must also be kept cool, with the use of ice, if necessary. The applicant is notified by telegraph on what train the fish will be shipped. If he does not meet the train, they cannot be delivered, but are carried on by the messenger to the next station where an applicant awaits a shipment.

The same care is required during the journey from the railway station to the streams that is given by the messenger on the train. Under no



Rearing pool of the Rome Fish and Game Protective Association.

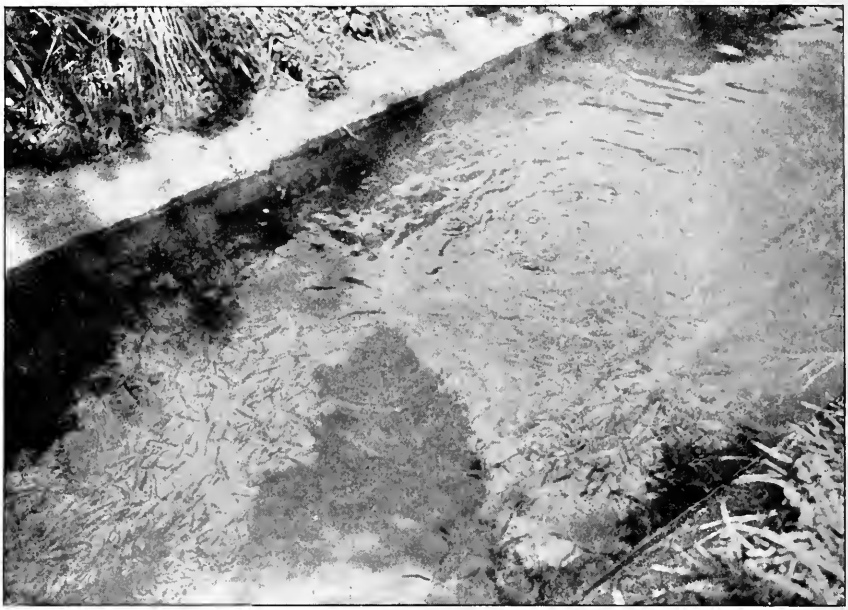
circumstances must the fry or fingerlings be kept in the cans over night without attention. It is necessary to take them directly to their destination and plant them at once. They should be protected as much as possible from jarring while being transported by wagon, to prevent injury to the young fish from being thrown against the sides and bottom of the cans.

Importance of Water Temperature

Just before actually placing the fish in the water, attention must be given to the temperatures of the water in the can and in the stream. If this vital point is neglected, the entire planting may be for naught, for a difference of only a few degrees between the two waters will kill young fish. A twenty-five cent dairy thermometer will show whatever variation there is. However small the variation may be, the temperatures must be equalized by dipping water from the can into the stream, and from the stream into the can, a little at a time. Another method is to stand the can in the stream, but this takes much longer.

Planting

When the temperature is right, the can may be emptied. The fish may be dipped out, or carefully poured from the can. In the latter case, the mouth of the can should be held no more than a few inches above the



Well developed fingerling trout in the Rome Association's Nursery.

stream, so that the fry will not be jarred by the impact of the water. The fish should be spread out as much as possible, some being planted in one place, and others a little farther away. No more than 500 fingerlings or 2000 fry should be planted per mile in a small stream. The food supply will be in danger of exhaustion in overstocked waters.

Artificial Stream Pools and Side Pools

One of the very best means that can be adopted for the protection of the fry of stream fish is the building of artificial stream pools. These are formed by damming up the headwaters of rivulets and little spring creeks. A number of dams, built of loose rocks, logs or boards, may be advantageously placed a short distance apart on the same stream. They not only insure a good water supply for the young fish in dry seasons, but also prevent them from being swept away by spring freshets. They also largely increase the area in which the natural food supply may grow, and over which the fish may forage for this food. By remaining in these pools near the headwaters, the fry gain security from the larger predaceous fish that lurk downstream. After attaining a suitable size, however, they will of their own accord seek the lower courses. Probably in most cases the stones or other materials for building the dams may be found on the spot. The structures need not be more than 12 or 15 inches in height. The tops of the dams should be as narrow as possible, and the water should fall over

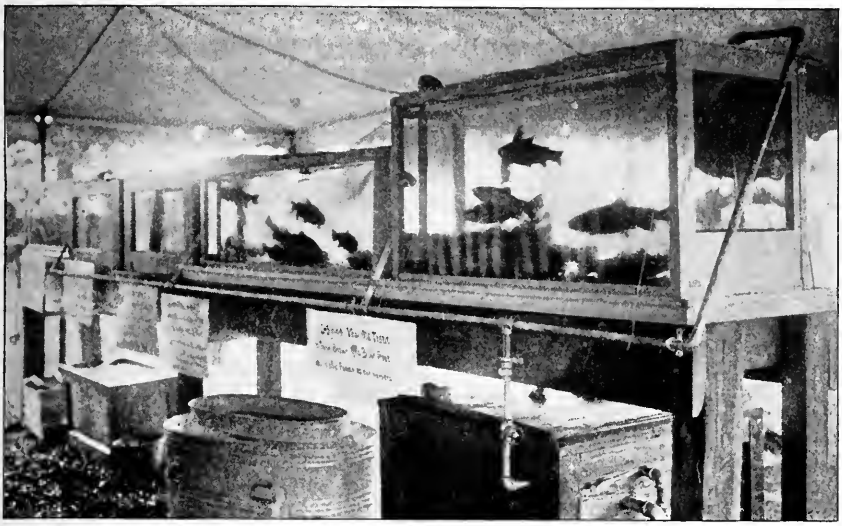


Exhibit of the Rome Fish and Game Protective Association at the Oneida County fair.

them in at least one place, in order that such fish as trout may leap over the obstruction without difficulty in ascending the stream to spawn in the fall. The beaver dams in the Adirondacks make stream pools on a large scale, and have greatly improved the trout fishing on the streams where they are located.

Side pools may be formed on large streams either by excavating suitable basins near the streams and diverting water through them, or by taking advantage of natural hollows and basins. The inlet from the stream and the outlet of the side pool should be screened to prevent the entrance of fish from the stream, which would prey upon the fry in the side pool. These pools, if sufficiently large, will provide enough natural food for a considerable number of fry. The fingerlings should be allowed to run into the main stream in the fall. On the headwaters of small streams, where large fish are not found, pools of this sort, that will require no screening, can often be made at small expense, and the fry in them will require no attention. Shade can easily be provided on the banks of side pools by the planting of willows and black alders. A few large rocks under which the little fish can hide, and boards supported from the bottom on stones, and weighted down with rocks to prevent floating away, will complete the arrangements.

Receiving and Rearing Stations

At times it has happened, through the over-production and over-crowding of fry in certain hatcheries, that they have been shipped when the brooks were still icebound or a spring freshet was in full force. In order to

tide the fish over until the weather conditions become suitable for planting, several fish and game associations that do planting on a large scale, including those at Rome, Middleville and Sherburne, and at Bennington, Vt., maintain receiving or rearing stations, or both. The receiving stations consist of a series of wooden or galvanized iron troughs, supplied with an abundance of pure running water, and located preferably indoors, where they are shielded from the strong rays of the sun. The troughs of a receiving station should be regulation hatchery troughs, specifications for which are given in Modern Fish Culture, by Fred Mather. Their good results amply justify the expenses of construction and operation, which are not large. The receiving stations, while designed primarily for emergency use, may be transformed into rearing stations to accommodate the young fish until they have reached the fingerling size. Far better than troughs for rearing purposes are large pools with sand or gravel bottoms and stone, concrete or wooden sides, or sides and bottoms entirely of concrete. Some fish culturists do not favor concrete, believing that its cracks harbor infection. Wood, properly treated with tar, is very satisfactory. Cypress is best, and hemlock is next in order. A high fence of chicken wire, with chicken wire covering the top, will sometimes be necessary to keep out herons and kingfishers. Rearing and receiving stations should be supplied

Aeration of the water between station and stream is of vital importance.

A dairy thermometer will give an accurate check on the temperature of the water in stream and can.

with an abundance of pure, cold, running water. Spring water is best, since it is not subject to pollution and flood variation. While the side pools described above can sometimes be made into satisfactory rearing stations for large numbers of fish, they are ordinarily not adapted to the crowding and forcing of a rearing station.

The station should be so located that regular feeding and attention can be given to the fish. Associations which are now operating rearing stations find it convenient to engage someone living nearby as caretaker. Volunteer labor for this purpose is ordinarily not to be advised, as the large number of fish that must be reared in such pools to justify their installation makes regular and responsible attention of much importance. The fish that are confined in rearing stations are subject to any of the diseases and accidents that are liable to occur among hatchery reared fish, and they should accordingly be closely watched. The more the caretaker knows of or can learn about fish culture, the more successful will be the work. In fact, successful fish culture is largely a matter of personal efficiency. At the first outbreak of anything that is not understood, an expert should be consulted. The Commission will be glad to render every possible assistance in this direction. Caretakers can learn much by visiting rearing stations already in operation by a number of associations. A trip to a State hatchery, some one of which is easily accessible from any part of the

Any difference in temperature between stream and can must be gradually equalized.

State, is particularly advisable prior to the installation of a rearing station.

While rearing stations are not to be lightly undertaken, the results that they bring in better fishing well justify the labor and expense that they involve.

Pollution

All those who are interested in the conservation of the aquatic life of the State realize that pollution of our watercourses must be kept at a minimum. There is no more precious gift of Nature than pure water. Yet many of our finest streams, and even some of the lakes, have become practically worthless as fishing waters through the agency of pollution. City sewage, as well as refuse from pulp and lumber mills, dye works, gas plants, dairy plants, metal factories, and various other manufacturing establishments, have long since spoiled the larger rivers. Even small trout streams are not safe from the drainage of cesspools, barnyards, outhouses, kitchen sinks, and garbage heaps. Pollution is an important contributory cause of diseases among fish, so that those which are not driven away at first remain merely to succumb eventually to poison and infection. All waters in which fishing is desired must have their purity safeguarded. It is no exaggeration to say that the greatest menace to fish culture in New York State today is pollution of the waters.

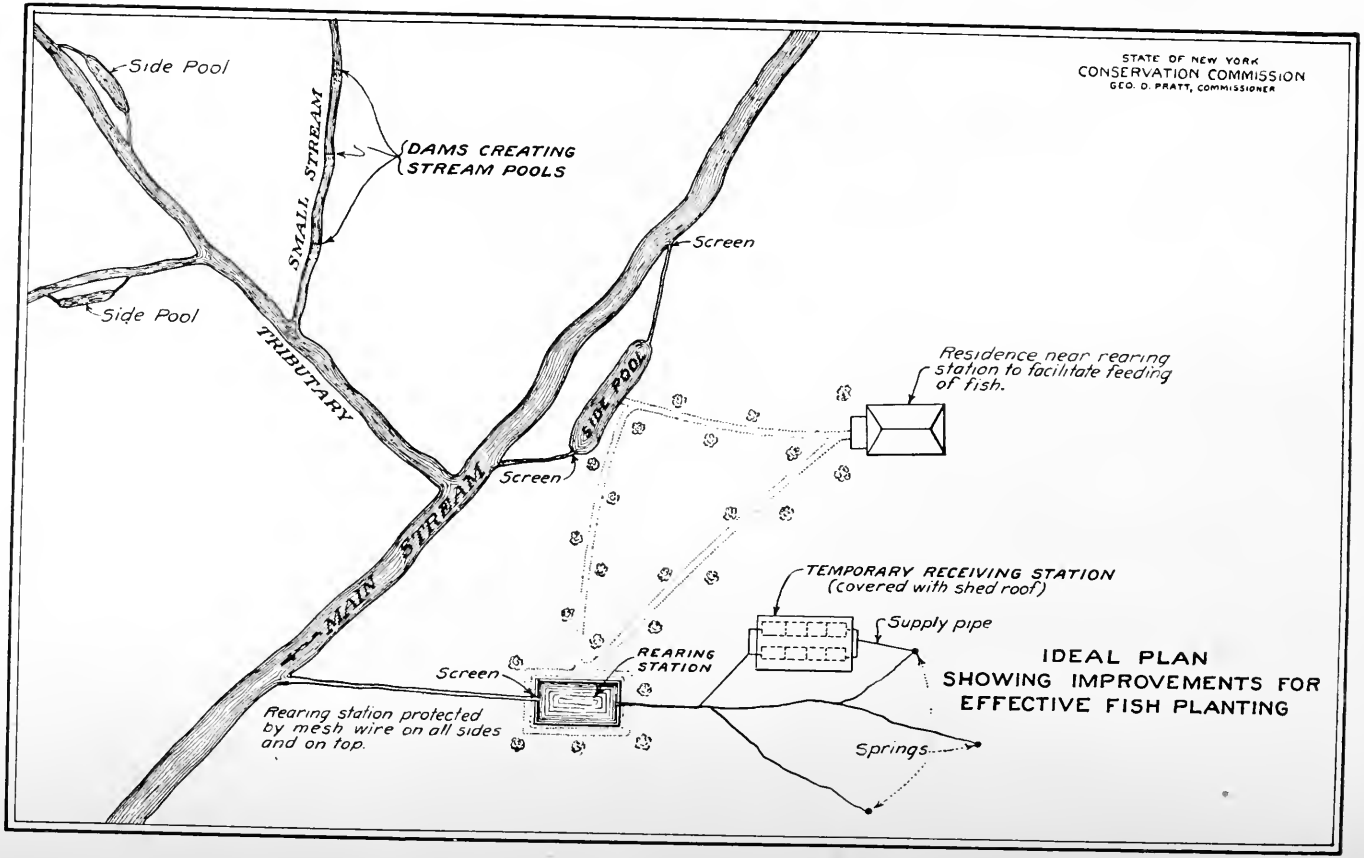
Planting fry with a dipper to avoid the shock of pouring.

Lampreys

The lake lamprey (*Petromyzon marinus unicolor*) is a parasitic creature that causes each year a tremendous loss to the inland fisheries of the State. It is abundant in Ontario, Oneida, Cayuga, and Seneca lakes, and doubtless in other lakes of the central part of the State.

The lamprey bears a marked resemblance to an eel, and is commonly called the "lamper eel." It is not at all closely related to the common eel, however, for the latter is a true fish; whereas the lamprey is scarcely a fish at all, being classed systematically with some of the very lowest forms of fishlike vertebrates. It is fitted by nature with a diabolical apparatus for preying upon valuable food and game fishes. Its mouth consists of a large, circular sucking disc, armed with horny teeth. By means of this sucking disc it attaches itself to some fish so firmly that it cannot be shaken off. The tongue also is strongly toothed, and works as a pistonlike rasp for boring through the skin and scales on the side of the fish. The victim's blood is then sucked out, so that it either dies from the attack or is left in such enfeebled condition that it is unfit for food and probably incapable of spawning. At times windrows of dead fish, showing wounds made by lampreys, have been cast up on the shores of Oneida Lake.

A full knowledge of the life history of any species of animal is essential to its economic control. Fortunately the life history of the lake lamprey is


STATE OF NEW YORK
CONSERVATION COMMISSION
GEO. D. PRATT, COMMISSIONER
Side Pool
SMALL STREAM
DAMS CREATING STREAM POOLS
Side Pool
TRIBUTARY
Screen
Residence near rearing station to facilitate feeding of fish.
SIDE POOL
Screen
MAIN STREAM
TEMPORARY RECEIVING STATION (covered with shed roof)
Supply pipe
REARING STATION
Screen
Rearing station protected by mesh wire on all sides and on top.
Springs
IDEAL PLAN
SHOWING IMPROVEMENTS FOR
EFFECTIVE FISH PLANTING

fairly well known, and a single very weak point in it has been found, by means of which steps may be taken for its control. In the deep waters of the lakes, where this parasite spends practically all of its adult life, it is fairly safe from any enemy. But in late May and early June it ascends the tributary streams to its spawning beds on sandy and gravelly shallows, usually just above riffles. There it can be captured very easily with a dip-net or spear, or even by hand. Like some members of the salmon family, the adult lampreys die shortly after spawning. It is thus essential to capture them as early as possible in the spawning season, before they have finished depositing their eggs. The same spawning beds are resorted to year after year, and when once located, it is a comparatively simple matter to visit them during two or three weeks each season for the purpose of cleaning out the lampreys.

Young lampreys in the larval state are an important bait for hook and line fishing. After hatching, they remain burrowed in the sand and mud of the stream beds for four years before reaching maturity. In order to obtain them, sand is shoveled up from the stream and thrown on the bank so that the water may drain away. As soon as the sand is pretty well drained, any larvae present will wriggle out to the surface, where they can be seen. The fisherman may thus not only secure an excellent bait, but also help materially in reducing the numbers of this serious pest.

A closely related form is the sea lamprey (*Petromyzon marinus*), which has similar destructive habits, and ascends coastwise streams in the spring for spawning purposes. It is common in the Delaware, the Susquehanna, and their tributaries, and on Long Island is found in Swan River, Nissequogue River, and doubtless other streams.

From every economic standpoint it would be advantageous to rid our waters entirely of lampreys. Associations and individuals interested in good fishing are urged to help in the work of limiting their number. All cooperation possible will be given by the Commission to this end.

Legal Sizes for Catching

Inquiries indicate that there are many persons who do not understand the exact significance and necessity of the six-inch law for brook trout, and of similar regulations regarding the size at which other species may be taken. Until an individual of a given species has reached the prescribed size, it has never spawned; and if all the individuals were caught before they had arrived at the spawning age, it is perfectly plain that the complete extermination of the species would be a matter of only a short time. It is therefore to the interest of every angler to see that under-sized fish are not destroyed. Every food and game fish should have a chance to spawn at least once before being taken.

Protection

The strongest ally of stocking is protection. Without the latter, the former will be quickly nullified. The game protective force is constantly on duty to prevent illegal fishing in all of its many forms, and accomplishes results which place it in the front rank among similar organizations in this country. It should be understood, however, that fully effective protection is dependent upon public cooperation. The force of any law is determined largely by the sentiment of the community to which it applies, and in a community which does not countenance game law violations, the violations are relatively few. It accordingly behooves everyone interested in better fishing to foster the development of a clean and sportsmanlike spirit regarding the observance of the fishing laws. Without such moral support and active cooperation on the part of sportsmen, the 450 square miles which every protector must police on the average cannot be thoroughly supervised. It should be realized by those who are doing the stocking that it is quite as important to effectively protect their fish after they are in the water as to place them there properly at the start.

DIRECTIONS FOR PLANTING VARIOUS SPECIES

Brook Trout; Speckled Trout (*Salvelinus fontinalis*)

The brook trout, probably the most highly prized of native fresh-water game fishes, inhabits cold, clear streams. Its distribution has been wonderfully extended by artificial propagation, both in this country and abroad. Its food consists of aquatic insects and their larvæ, and crustaceans, mollusks, worms and fish of small size.

The streams to be stocked should not rise above 68 degrees in temperature during the summer. Brook trout will not live and thrive in warmer waters. It has been found in various parts of the State that certain streams formerly abounding in brook trout will no longer support this species, and in many cases it is quite evident that this is directly due to the cutting off of the forests and the consequent increase in temperature of the waters through exposure to the sun. The banks of the streams should be grown with trees or tall shrubs in order to provide the necessary shade and coolness. Where the vegetation has been removed, black alder or quick-growing willows may be advantageously planted along the banks. It is useless to place trout in waters made impure with sewage, mill, dairy or other refuse, for they are peculiarly sensitive to pollution and will not remain in such waters.

The best places for planting are the rivulets and spring feeders, tributary to the larger streams, into which the fish will work their way as they grow. Make sure that the brooks are not such as will dry up or become stagnant during the summer. Rearing pools on the streams, and side pools, which have been described in the preceding pages, are particularly advantageous for brook trout.

The fry are ready for distribution in March or April; the fingerlings from May to July. The latter should not be planted in quite such small streamlets as the fry.

Rainbow Trout (*Salmo irideus*)

This is a native of the mountain streams of the Pacific coast, where it occasionally descends to the lower stretches of the rivers and even passes out to sea. It has been extensively introduced in the East, and is fairly established in New York. Its flesh is much esteemed, and its game qualities are scarcely inferior to the brook trout's. Its food as well as its habitat is similar to that of the latter species, and both fishes will live in harmony in the same waters. The rainbow, however, seems to show a tendency to work downstream, passing over dams and falls that it cannot ascend again, thus abandoning the headwaters. It has been introduced with great success into lakes that are landlocked, so that it cannot escape. Such lakes should have small tributary streams up which the rainbow can run to spawn. The same planting methods may be employed for either species.

Since the rainbow spawns somewhat later than the brook trout, the fry are not ready for shipment till May or June. The fingerlings are available from July to September.

Brown Trout (*Salmo fario*)

The brown trout is a native of Europe, and has become acclimatized in in many parts of the United States. It is very hardy, and ranks as one of the finest game fishes. It lives in clear, cold, rapid streams. Its food habits are in general similar to those of the two preceding species, but since this fish grows to a much larger size and preys upon the others, it should never be introduced into waters already supplied with native trout. It withstands a higher summer temperature than the brook trout, and has replaced that species in certain waters where the surrounding forests have been largely cleared away.

The fry are shipped in March or April, the fingerlings from May to July. Plant as in the case of the brook trout.

Lake Trout (*Cristivomer namaycush*)

This is one of the largest and most beautiful of native species of the salmon family. It thrives only in cold, deep lakes. It is an omnivorous and ravenous feeder, subsisting chiefly upon ciscoes or lake herrings and other small fish.

The fry are ready for distribution in March or April; the fingerlings from May to July. Plant on rocky shoals or reefs in lakes, very near to deep water.

Land-locked Salmon (*Salmo salar sebago*)

Only a small number of eggs of this species are obtainable, through the United States Bureau of Fisheries, and all the fry are planted by the Commission in Lake George.

Common Whitefish (*Coregonus clupeaformis*)

The common whitefish, probably the most esteemed of all fresh-water food fishes, is found in Lake Ontario, some of the Adirondack lakes, Otsego lake, and several other lakes in the central and western parts of the State. Its range extends through the Great Lakes region and a large part of Canada. It is an inhabitant of cold, deep water, coming to the shallower parts to spawn. It may be taken with hook and line, but is usually caught in nets. The food of the adults consists largely of crustaceans, and also of mollusks, insect larvæ, and small fish; that of the fry and young fish is almost wholly small crustaceans.

The fry are distributed in March and April, and should be planted in the shoal parts of lakes.

Round Whitefish or Frostfish (*Coregonus quadrilateralis*) Lake Erie Herring (*Leucichthys artedi*) Ontario or Greenback Herring (*Leucichthys ontariensis*) Tullibee (*Leucichthys tullibee*)

These small relatives of the common whitefish are excellent for the table, and also have great value as food for the lake trout. The frostfish is found in lakes of the Adirondack region, the Lake Erie herring chiefly in Lake Erie, the greenback herring in Lake Ontario and Cayuga lake, and the tullibee in Oneida lake. Their food habits are in general similar to those of the common whitefish.

The fry are ready for distribution in March and April, and are usually planted by the Commission in the waters from which the eggs were collected.

Pike-Perch; Wall-Eyed Pike (*Stizostedion vitreum*)

The pike-perch is one of the most valuable of fresh-water fish for both its food and its game qualities. It prefers lakes and rivers with clear water, and with rock, gravel, sand, or hard-clay bottom. It feeds upon minnows, crawfish, and insects and their larvæ.

The fry are distributed in May, within a few days after hatching. They may be planted on sandy or rocky shoals in lakes and their tributaries.

Yellow Perch (*Perca flavescens*)

The yellow perch is one of the commonest and best known of our fresh-water species. It is a gamy fish, and its flesh is of fair quality. It is found in lakes, ponds, and rivers. It feeds upon small fishes, crustaceans, and other animal matter.

Fry are available in May and June; fingerlings from September to November. Plant in shallow parts of the waters to be stocked.

Small-Mouthed Black Bass (*Micropterus dolomieu*)

This gamy and important fish thrives in pure, rapid, fairly clear streams, and also in lakes and ponds. The food of the adult consists of

crawfish, frogs, insects and their larvæ, minnows, worms, and mussels; of the young, crustaceans, insects, and insect larvæ.

The black bass is not propagated artificially, but the adults are placed in hatchery ponds, where they spawn naturally. Fingerlings are available for distribution in September, and may be planted in the shallow parts of the waters to be stocked. The Conservation Law, however, forbids introduction of bass into natural trout waters.

Calico Bass; Strawberry Bass (*Pomoxis sparoides*)

This small bass occurs in streams as well as in lakes and ponds, and is a very good fish. Its average weight is about one pound. Its food consists of worms, small crustaceans, and fishes.

Fingerlings are available at the same time, and may be planted in the same way as black bass.

Maskalonge (*Lucius ohiensis*)

This largest representative of the pike family has an average weight of 25 or 30 pounds. As a game fish it has few superiors, and its flesh is of very good quality. It is propagated only at the Chautauqua Station, and the only waters in which it should be placed are those belonging to the Ohio basin. Its food consists mainly of smaller fishes, and its voracity is notorious.

Young fishes may be planted in May and June near the shores of lakes.

Smelt; Ice-fish (*Osmerus mordax*)

This marine species ascends rivers to spawn, and it has been introduced or land-locked in Lake Champlain and other lakes of the State. It is in great demand as a table fish, and is also useful in furnishing food for land-locked salmon and lake trout.

The eggs are collected in March by the Long Island Station, and may be shipped in the eyed stage a short time thereafter. They should be planted in small, rocky streams tributary to the lake that it is desired to stock. Since the eggs are adhesive, they become attached to stones, sticks, and other objects, where they remain until hatched.

Shad (*Alosa sapidissima*) **Alewife or River Herring** (*Pomolobus pseudoharengus*)

These two species are hatched at the Linlithgo Station, and are planted by the Commission in the Hudson river only.

Sea Bass; Blackfish (*Centropristes striatus*) **Scup; Porgy** (*Stenotomus chrysops*) **Tomcod** (*Microgadus tomcod*) **Flatfish; Winter Flounder** (*Pseudopleuronectes americanus*) **Lobster** (*Homarus americanus*) **Blue Crab** (*Callinectes sapidus*)

These species are propagated by the Long Island Station. They are intended only for the marine waters of Long Island, and are planted by the Commission.

Points to Remember

1. Make plans for stocking during the previous season.
2. Fill out application blanks for fry or fingerlings in due time. Those for trout must reach the Commission before February 1st; for other species, before April 1st.
3. The construction of stream pools and side pools will save many young fish.
4. Ascertain, if possible, the natural food supply available for the fish in the waters to be stocked, to make sure of their growth after planting.
5. Keep the streams free from pollution if good fishing is desired.
6. Do not fail to meet the shipment at the train; otherwise it cannot be delivered.
7. Keep the cans of fish from unnecessary shock and jar, and aerate the water frequently.
8. Equalize the temperature of the water in the can and in the stream as the final step before planting.
9. Spread the fish out well in planting.
10. The construction of a receiving station and of a nursery for rearing fry to fingerlings will make results more certain.
11. Illegal fishing will nullify the best stocking that can be done. Everyone can help in putting this down.
12. Efficiency and eternal vigilance are the price of fish.

Books on Fishing and Fish Culture

1. Manual of Fish Culture, Revised Edition, U. S. Bureau of Fisheries. Washington, D. C. 1906.
2. The Farm Fishpond, by George C. Embody. The Cornell Reading-Course, Vol. IV, No. 94, Ithaca, N. Y. 1915.
3. American Food and Game Fishes, by David Starr Jordan and Barton Warren Evermann. Doubleday, Page & Co., New York. 1902.
4. Modern Fish Culture, by Fred Mather. Forest and Stream Publishing Co., New York. 1900.
5. Fish Culture, by William E. Meehan. Sturgis & Walton Co., New York. 1913.
6. The Potamogetons in Their Relation to Pond Culture, by Emmeline Moore. U. S. Bureau of Fisheries. 1915.
7. The Book of Fish and Fishing, by Louis Rhead. Charles Scribner's Sons, New York.
8. Domesticated Trout, by Livingston Stone. Osgood, Boston. 1872.
9. Aquatic Plants in Pond Culture, by John W. Titcomb. U. S. Bureau of Fisheries. 1909.
10. The Home Aquarium, by Eugene Smith. E. P. Dutton & Co., New York.

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